# WHAT IS CLAIMED:

- 1. A method for generating a local oscillator (LO) frequency in a multi-band direct
- 2 conversion wireless communication device, the method comprising:

receiving a signal, from a voltage controlled oscillator (VCO), having a VCO

4 frequency;

dividing the VCO frequency by a number N to produce a signal having a divided-

6 down frequency; and

mixing the signal having the VCO frequency with the signal having the divided-

- 8 down frequency to produce an output signal having an output frequency.
  - 2. The method of claim 1, wherein the output frequency is the LO frequency.
  - 3. The method of claim 1, further comprising dividing the output frequency by a
- 2 number M to produce a second output frequency.
  - 4. The method of claim 1, further comprising shifting the phase of the output
- 2 signal.
  - 5. The method of claim 1, wherein the VCO frequency is divided by a number N
- 2 when a control signal is received.
  - 6. The method of claim 1, wherein the device includes a receiver.



#### Docket No. 010073U2 EL831391935US

- 7. The method of claim 6, wherein the output frequency is the LO frequency for
- the receiver, further comprising mixing the output signal with a signal having an offset frequency to produce an LO frequency for a transmitter.
  - 8. The method of claim 1, wherein the device includes a transmitter.
  - 9. A method for generating a local oscillator (LO) frequency in a multi-band direct
- 2 conversion wireless communication device, the method comprising:

receiving a signal, from a voltage controlled oscillator (VCO), having a VCO

4 frequency;

dividing the VCO frequency by a number N to produce a signal having a divided-

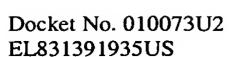
6 down frequency;

dividing the divided-down frequency by a number M to produce a second signal

8 having a further divided-down frequency; and

mixing the signal having the VCO frequency with the second signal having the

- 10 further divided-down frequency to produce an output signal having an output frequency.
  - 10. The method of claim 9, further comprising dividing down the output frequency
- 2 by a number P.
  - 11. The method of claim 9, wherein the VCO is a multi-band VCO.
  - 12. A method for generating a local oscillator (LO) frequency in a multi-band
- 2 direct conversion wireless communication device, the method comprising:



configuring an LO generator to have one or more configurations, each

- 4 configuration being associated with at least one frequency band of RF signals and producing an output signal whose frequency is associated with the at least one frequency
- band of RF signals, and to mix a VCO frequency with a divided-down version of the VCO frequency;
- choosing a frequency band of RF signals; and selecting a configuration associated with the chosen frequency band of RF signals.
- 13. The method of claim 12, further comprising controlling the LO generator
  2 based on the selecting.
- 14. A system for generating a local oscillator (LO) frequency in a multi-band
   2 direct conversion wireless communication device, the system comprising:
  - a voltage controlled oscillator (VCO);
- a divider having an input and an output produced by dividing an input signal, the divider input being operatively coupled to the VCO; and
- a mixer having a first mixer input operatively coupled to the VCO, a second mixer input operatively coupled to the divider output, and an output.
  - 15. The system of claim 14, wherein the mixer output provides the LO frequency.
- 16. The system of claim 14, wherein the VCO is external to a chip that includes2 the device.

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## Docket No. 010073U2 EL831391935US

- 2 17. The system of claim 16, wherein the VCO has a single-ended output.
- 18. The system of claim 14, wherein the VCO is integrated in a chip that includes 2 the device.
- 19. The system of claim 14, wherein the VCO operates below a frequency of RF2 signals.
- 20. The system of claim 14, wherein the VCO operates above a frequency of RF2 signals.
- 21. The system of claim 14, wherein the VCO operates at frequencies between
   2 1600 and 1788 MHz.
- 22. The system of claim 14, wherein the VCO is operatively coupled to a phase-
- locked loop (PLL), further comprising a second PLL and a second VCO for signals received when in a GPS mode, the second VCO operating at two times the frequency of
- 4 received GPS signals.
- 23. The system of claim 22, further comprising a third PLL and a third VCO for
   signals received when in a Bluetooth mode.
- 24. The system of claim 14, wherein the mixer includes a single side band (SSB)2 mixer.

- 25. The system of claim 24, wherein the SSB mixer is a low side SSB mixer.
- 26. The system of claim 24, wherein the SSB mixer is a high side SSB mixer.
- 27. The system of claim 14, wherein the mixer output is operatively coupled to a phase-locked loop (PLL), wherein the PLL is internal to a chip that includes the device.
- 28. The system of claim 14, wherein the divider input is selectively coupled to the VCO.
- 29. The system of claim 28, wherein a switch selectively couples the divider input to the VCO.
- 30. The system of claim 29, wherein the switch is controlled by a switch control based on a band of the RF signals.
- 31. The system of claim 14, wherein the divider input is selectively coupled to the mixer output.
- 32. The system of claim 14, wherein the mixer output is selectively coupled to the VCO.
- 33. The system of claim 14, further comprising a phase shifter having an input coupled to the mixer output, the phase shifter having an output that produces quadrature signals.



#### Docket No. 010073U2 EL831391935US

- 34. The system of claim 33, wherein the phase shifter comprises an active phaseshifter.
- 35. The system of claim 14, further comprising a second divider having an input
  2 operatively coupled to the mixer output and an output produced by dividing an input
  signal.
  - 36. The system of claim 35, wherein the second divider divides by 2.
- 37. The system of claim 35, wherein the second divider outputs a first signal and a
   second signal, the first signal being 90 degrees out of phase of the second signal.
- 38. The system of claim 37, wherein the first signal drives one of an I and Q mixer in the device.
  - 39. The system of claim 14, wherein
- 2 the device includes a receiver, wherein
  - a band of received RF signals is US PCS, and wherein:
- the VCO operates between frequencies of 1716 MHz and 1769 MHz, the divider divides by 8, and
- 6 the mixer is a high side SSB mixer.
  - 40. The system of claim 14, wherein
- 2 the device includes a receiver, wherein

- a band of received RF signals is IMT, and wherein:
- the VCO operates between frequencies of 1688 MHz and 1736 MHz,
  - the divider divides by 4, and
- 6 the mixer is a high side SSB mixer.
  - 41. The system of claim 14, wherein the device is included in a wireless
- 2 communication transceiver.
  - 42. The system of claim 14, wherein the device includes a transmitter.
  - 43. The system of claim 42, wherein
- a band of transmitted RF signals is US PCS, and wherein:

the VCO operates at frequencies between 1480 MHz and 1528 MHz,

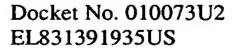
the divider divides by 4, and

the mixer is a high side SSB mixer.

- 44. The system of claim 42, further comprising a first amplifier chain configured to operate in a first transmit frequency band, the amplifier chain being operatively coupled to an upconverter.
  - 45. The system of claim 14, wherein the device includes a receiver, and further
- comprising an offset LO coupled to a third input of the mixer, wherein the mixer output provides an LO frequency for a transmitter.

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- 46. The system of claim 14, wherein the first mixer input and the mixer output are differential.
- 47. The system of claim 14, wherein the device includes a receiver that incorporates differential signal paths.
- 48. A system for generating a local oscillator (LO) frequency in a multi-band direct conversion wireless communication device, the system comprising:

  a voltage controlled oscillator (VCO);
- a first divider having an input and an output produced by dividing an input signal, the input of the first divider being operatively coupled to the VCO;
  - a second divider having an input and an output produced by dividing an input signal, the input of the second divider being operatively coupled to the output of the first divider; and
- a mixer having a first mixer input operatively coupled to the output of the first divider, a second mixer input operatively coupled to the output of the second divider, and an output.
- 49. The system of claim 48, further comprising a third divider operatively coupled
   to the mixer output.
  - 50. The system of claim 48, wherein the VCO is a multi-band VCO.
- 51. A system for generating a local oscillator (LO) frequency in a multi-band direct conversion wireless communication device, the system comprising:

## Docket No. 010073U2 EL831391935US

an LO generator having one or more configurations, each configuration being

- 4 associated with at least one frequency band of RF signals and producing an output signal whose frequency is associated with the at least one frequency band of RF signals, and a
- 6 mixer configured to mix a VCO frequency with a divided-down version of the VCO frequency; and
- a configuration selection mechanism arranged to select a configuration associated with a chosen frequency band of RF signals.
- 52. The system of claim 51, wherein the LO generator is controlled based on the configuration selection mechanism.